CLAIMS

What is claimed is:

1. A system using neurological control signals to control a device comprising:

a sensor sensing electrical activity of a plurality of neurons over time;

a vector generator generating a neural control vector from the sensed electrical activity of the plurality of neurons over time;

a control filter to which the neural control vector is applied to provide a control variable; and

a output device controlled by the control variable.

2. A system according to claim 1 wherein the electrical activity comprises action potentials of a neuron.

3. A system according to claim 1 wherein the electrical activity is recorded by electrodes implanted in a central nervous system.

4. A system according to claim 1 wherein the electrical activity is recorded as a subdural electrocortigram signal.

5. A system according to claim 1 wherein the electrical activity is recorded as an electroencephalogram signal.

6. A system according to claim 1 wherein the electrical activity comprises a subthreshold potential of a neuron.

7. A system according to claim 1 wherein the electrical activity of neurons is sensed over successive time bins.

8. A system according to claim 1 wherein the electrical activity of neurons is a motor control command linked to a motor output performed by the motor output device.

9. A system according to claim 1 wherein the sensor comprises an array of electrical sensing elements.

10. A system according to claim 1 wherein the control filter, when applied to the neural control vector, provides the least mean square error between an output of the motor output device and an intended output.

11. A system according to claim 1 wherein error is minimized by a nonlinear weighting of the neural control vector.

12. A system according to claim 1 wherein error is minimized by human interaction with the control filter.

13. A system according to claim 1 further comprising a neural network of one or more layers, each layer having one or more nodes, wherein the neural network reduces the error between an output of the motor output device and an intended output.

14. A system according to claim 1 wherein the motor output device is an animal limb.

15. A system according to claim 14 wherein the animal limb is prosthetic.

16. A system according to claim 1 wherein the motor output device is a part of the human body.

17. A system according to claim 1 wherein the motor output device is a computer input device.

18. A system according to claim 1 wherein the motor output device is a robotic arm.

19. A system according to claim 1 wherein the motor output device is a neuromuscular stimulator system.

20. A system according to claim 1 wherein the motor output device is an electrode array.

21. A system according to claim 1 wherein the motor output device is a wheelchair.

22. A system according to claim 1 wherein the motor output device is a home appliance.

23. A system according to claim 1 wherein the motor output device is a navigational system for a vehicle.

24. A system according to claim 1 wherein the motor output device is a telerobot.

25. A system according to claim 1 wherein the motor output device is an external voice synthesizer.

26. A system according to claim 1 wherein the motor output device is a microchip.

27. A system according to claim 1 wherein the motor output device is a biohyprid neural chip.

28. A system according to claim 7 wherein the electrical activity of neurons is sensed over 1 to 1000 time bins.

29. A system according to claim 7 wherein each time bin is 1 to 1000 ms.

30. A system according to claim 9 wherein the array comprises 1 to 1000 sensing elements.

31. A system according to claim 1 wherein the application of the control filter to the neural control vector is an instantiation of an innerproduct.

32. A method for controlling a device comprising:

providing a sensor sensing electrical activity of a plurality of neurons over time;

generating a neural control vector from the sensed electrical activity of the plurality of neurons;

providing a control filter;

calculating an innerproduct between the neural control vector and the control filter to provide a control variable; and

controlling an output device with the control variable.

33. The method of claim 32 wherein the electrical activity is the firing of the neurons.

34. The method of claim 32 wherein the electrical activity of neurons is sensed over successive time bins.

35. The method of claim 32 wherein the electrical activity of neurons is a motor control command linked to a motor output performed by the motor output device.

36. The method of claim 32 wherein the sensor comprises an array of electrical sensing elements.

37. The method of claim 32 wherein the filter for calculation of a control variable provides the least mean square error between an output of the motor output device and an intended output.

38. The method of claim 32 wherein the motor output device is an animal limb.

39. The method of claim 38 wherein the animal limb is prosthetic.

40. The method of claim 32 wherein the motor output device is a part of the human body.

41. The method of claim 32 wherein the motor output device is a computer input device.

42. The method of claim 34 wherein the electrical activity of neurons is sensed over 1 to 1000 time bins.

43. The method of claim 34 wherein the time bin is 1 to 1000 ms.

44. The method of claim 36 wherein the array comprises 1 to 1000 sensing elements.

45. The method of claim 32 wherein the application of the neural control vector to the control filter results in an innerproduct.

46. A method of generating a control filter comprising:

providing a sensor sensing electrical activity of a plurality of neurons over time;

generating a neural control vector from the sensed electrical activity of the plurality of neurons;

calculating filter coefficients which when applied to the neural control vector reconstructs motor control parameters.

47. The method of claim 46 further comprising calibration by tracking a stimulus moving through a motor workspace in at least one spatial dimension.

48. The method of claim 47 further comprising calibration based on a psuedorandom tracking task.

49. The method of claim 46 further comprising calibration whereby a user acquires stationary and moving targets in at least one spatial dimension using a neural control signal with previously generated filters and neural and kinematic data concurrent with the target acquisition to build new filters.

50. A system using neurological control signals to control a device comprising:

a means for sensing electrical activity of a plurality of neurons over time;

a means for generating a neural control vector from the sensed electrical activity of the plurality of neurons over time;

a control filter;

a means for calculating an innerproduct between the neural control vector and the control filter to provide a motor control variable; and

a motor output device controlled by the motor control variable.

51. A method for controlling a device comprising:

providing a sensor sensing electrical activity over time;

generating a control vector from the sensed electrical activity;

providing a control filter;

calculating an innerproduct between the control vector and the control filter to provide a control variable; and

providing an output device controlled by the control variable.

52. A system according to claim 1 wherein error is minimized by sensory feedback.